/ ***Marley Sigma – Series 10/15 – Class 160*** *Cooling Towers* /

User Manual 92-1319G

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Contents

Note

This manual contains vital information for the proper installation and operation of your cooling tower. Carefully read the manual before installation or operation of the tower and follow all instructions. Save this manual for future reference.

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The following defined terms are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning the life of the product.

⚠ Warning

Indicates presence of a hazard which can cause severe personal injury, death or substantial property damage if ignored.

⚠ Caution

Indicates presence of a hazard which will or can cause personal injury or property damage if ignored.

Note

Indicates special instructions on installation, operation or maintenance which are important but not related to personal injury hazards.

These instructions–as well as those offered separately on motors, fans, Geareducers, drive shafts, float valves, etc.–are intended to assure that your Marley cooling tower serves you properly for the maximum possible time. Since the tower's warrantability may well depend upon your actions, please read these instructions thoroughly prior to operation.

If you have questions about the operation and/or maintenance of this tower, and you don't find the answers in this manual, please contact your Marley sales representative. When writing for information, or when ordering parts, please mention tower serial number shown on the nameplate.

Operation

⚠ **Warning**

The cooling tower must be located at such distance and direction to avoid the possibility of contaminated tower discharge air being drawn into building fresh air intake ducts. The purchaser should obtain the services of a Licensed Professional Engineer or Registered Architect to certify that the location of the tower is in compliance with applicable air pollution, fire, and clean air codes.

Tower Startup

⚠ **Warning**

Among other sources, outbreaks of Legionnaires' Disease have reportedly been traced to cooling towers. Maintenance and water treatment procedures that prevent amplification and dissemination of Legionella and other airborne bacteria should be formulated and implemented BEFORE systems are operated and continued regularly thereafter to avoid the risk of sickness or death.

When you first start up your tower, or when you start up after a prolonged shutdown, you should thoroughly clean and inspect the tower. The following checklist will help to guide you through this procedure.

Water System

1. New installations should be cleaned and treated with biocides by a water treatment expert before startup.
2. Remove any and all accumulated debris from tower. Pay particular attention to inside areas of cold water basin, entire hot water basin, and air inlet louvers. Make sure that cold water suction screens and sump are clear and properly installed. Check to see that nozzles in hot water distribution basin are properly installed and free of debris. Use low-pressure water stream as necessary to clean hot and cold water basins and the fill area.
3. For Series 10 and Series 15 cooling towers with wood collection basins, fill the water system to an approximate depth of 5". For Sigma and Class 160 cooling towers with wood or steel collection basins, fill the water system to a depth of 6". This is the recommended operating water level. Adjust the float valve so that it is essentially closed at that level. Continue filling the system until the water reaches a level approximately ⅛" below the lip of the overflow.

Operation

For Series 10 towers with concrete cold water basin, the operating water level should be 6 ½" below top of basin curb wall. For Series 15 towers with concrete cold water basin, the operating water level should be 11" below top of basin curb wall. For Sigma and Class 160 cooling towers with concrete cold water basin, the operating water level should be 1'-0" below top of basin curb wall. Special air baffles under the fill will allow you to operate at lower water levels without allowing air to bypass below the tower fill. Your Marley sales representative will gladly help you to meet this need.

Note

Prewetting your wood collection basin for several days will cause the lumber to swell, eliminating most basin leaks. If leaks exist after several days, apply a polyurethane sealer to the leaking joints.

You can eliminate most leaks in steel basins by tightening the bolted joints and sealing with polyurethane sealer.

4. Completely open all hot water flow control valves. Start your pump(s). Observe system operation. Since the water system external to the tower will have been filled only to the level achieved in the cold water basin, a certain amount of "pump-down" of the basin water level will occur before water completes the circuit and begins to fall from the fill. The amount of initial pump-down may be insufficient to cause the float valve to open. However, you can check its operation by pressing down on the operating lever to which the stem of the float valve is attached.
5. While operating the condensing water pump(s) and prior to operating the cooling tower fan, execute one of the two alternative biocidal treatment programs described in the following:
   - Resume treatment with the biocide which had been used prior to shut-down. Utilize the services of the water treatment supplier. Maintain the maximum recommended biocide residual (for the specific biocide) for a sufficient period of time (residual and time will vary with the biocide) to bring the system under good biological control
     or
   - ***Treat the system with sodium hypochlorite to a level of 4 to 5 mg/L (ppm) free chlorine residual at a pH of 7.0 to 7.6. The chlorine residual must be held at 4 to 5 mg/L (ppm) for six hours, measurable with standard commercial water test kits.***

   If the cooling tower has been in operation and then shut down for a duration of time and not drained, perform one of the two previous biocidal

treatment programs directly to the cooling water storage vessel (cooling tower sump, drain down tank, etc.) without circulating stagnant water over the cooling tower fill or operating the cooling tower fan.

After biocidal pretreatment has been successfully completed, cooling water may be circulated over the tower fill with the fan off.

When biocidal treatment has been maintained at a satisfactory level for at least six hours, the fan may be turned on and the system returned to service. Resume the standard water treatment program, including biocidal treatment.

After reaching design water flow rate, adjust the valves to equalize hot water depth in the distribution basins. See the following table for hot water basin depths for various models. Water basin depth should be uniform basin to basin. Lock valves in desired position by tightening the locking

Tower Model	Distribution Basin Depth
Series 10	2"– 4"
Series 15	3" – 5 ½"
Sigma Steel	3" – 5 ½"
Sigma Wood	3" – 8"
Sigma F Series	3" – 8"
Class 160	3" – 8"

bar. Coat the exposed valve stem with a marine type grease.

Note

Sigma F Series towers are self balancing and do not require valve adjustment from one side of cell to the other. Adjust valves in supply piping to balance flow from cell to cell on multicell tower installations.

Uniform distribution basin depth is essential for efficient tower operation. Contact your Marley sales representative if you are considering a change in circulating water flow rate that would prevent operation within these limits.

Mechanical Equipment

⚠ Warning

Always make certain that mechanical equipment is inoperable during periods of maintenance–or during any situation of possible endangerment to personnel. If your electrical system contains a disconnect switch, lock it out until the period of exposure to injury is over.

1. Check the Geareducer oil level at the sight glass or dip stick near the motor. If oil is required, fill to the proper level.
2. Spin the fan manually to assure that all fan blades properly clear the inside

of the fan cylinder. Observe the action of the drive shaft couplings to be sure that the motor and Geareducer are properly aligned. If necessary, correct the alignment in accordance with the included drive shaft manual. Ensure that fan blades are pitched uniformly and that each blade is installed in its proper hub socket.

3. Momentarily energize ("bump") the motor and observe rotation of the fan. The fan should rotate in a counterclockwise direction when viewed from below. If rotation is backwards, shut off the fan and reverse two of the three primary leads supplying power to the motor.

⚠ Caution

If tower is equipped with a two-speed motor, check for proper rotation at both speeds. Check also to see that starter is equipped with a 20 second time delay which prevents direct switching from high speed to low speed. This delay will allow the fan to slow down, and will prevent abnormal stress from being applied to the mechanical equipment and the electrical circuit components.

4. Run the motor and observe the operation of the mechanical equipment. Operation should be stable, and there should be no evidence of oil leakage. In general, you should allow several days of operation before evaluating vibration. A wood structure must be thoroughly wet in order to provide proper mechanical dampening.

Note

If the water supply system is not being operated–or if there is no heat load on the system–motor amps read at this time may indicate an apparent overload of as much as 10–20%. This is because of the increased density of unheated air flowing through the fan. Determination of an accurate motor load should await the application of the design heat load.

Tower Operation

General:

The cold water temperature obtained from an operating cooling tower will vary with the following influences:

1. **Heat load:** With the fan in full operation, if the heat load increases, the cold water temperature will rise. If the heat load reduces, the cold water temperature will reduce.

Operation

The number of degrees ("range") through which the tower cools the water is established by the system heat load and the amount of water being circulated, in accordance with the following formula:

$$\text{Range (°F)} = \frac{\text{Heat Load (Btu/hr)}}{\text{GPM x 500}}$$

The cooling tower establishes only the cold water temperature attainable under any operating circumstance.

2. **Air wet-bulb temperature:** Cold water temperature will also vary with the wet-bulb temperature of the air entering the louvered faces of the tower. Reduced wet-bulb temperatures will result in colder water temperatures. However, the cold water temperature will not vary to the same extent as the wet-bulb. For example, a 20°F reduction in wet-bulb may result in only a 15°F reduction in cold water temperature.
3. **Water flow rate:** Increasing the water flow rate (GPM) will cause an elevation in cold water temperature, while reducing the water flow rate will cause the cold water temperature to lower. However, at a given heat load (see formula above), GPM reductions also cause an increase in the incoming hot water temperature. Unless your tower was specifically designed for higher hot water inlet temperatures, use care to prevent the hot water from exceeding 120°F to prevent damage to tower components.
4. **Air flow rate:** Reducing air flow through the tower causes the cold water temperature to rise. ***This is the approved method by which to control leaving water temperature.***

   If your tower is equipped with a single-speed motor, the motor may be shut off when the water temperature becomes too cold. This will cause the water temperature to rise. When the water temperature then becomes too warm for your process, the motor can be restarted.

Fan cycling limits:

Note

On 20 foot diameter fans and smaller, anticipate that approximately 4 to 5 starts per hour are allowable. On larger fans, 1 or 2 starts per hour may be the limit.

If your tower is equipped with a two-speed motor, you will have greater opportunity for temperature control. When the water temperature becomes too cold, switching the fan to half-speed will cause the cold water

temperature to rise–stabilizing at a temperature some 5° to 15° higher, depending upon a combination of all operating factors. With a further reduction in water temperature, the fan may be cycled alternately from half-speed to off.

Note

Do not start the motor more than four to five times per hour (each low speed start and each high speed start count as one start).

If your tower consists of two or more cells, cycling of motors may be shared between cells, increasing your steps of operation accordingly.

For greater insight on cold water temperature control, please read *Technical Report #H-001-A* **"Cooling Tower Energy and its Management**", available from your Marley sales representative.

Wintertime Operation

During operation in subfreezing weather, the opportunity exists for ice to form in the colder regions of the tower. ***Your primary concern is to prevent the formation of destructive ice on the cooling tower fill***. Your understanding of cold weather operation will be enhanced if you read *Technical Report #H-003* **"Operating Cooling Towers in Freezing Weather"**, augmented by the following guidelines:

1. Do not allow the tower's leaving water temperature to drop below a minimum allowable level–about 40°F–established as follows:

   During the coldest days of the first winter of operation, observe whether any ice is forming on the louver face, particularly near the bottom of the louver face. If hard ice is present on the louvers, an appropriate elevation in the allowable cold water temperature is mandatory. If the coldest possible water is beneficial to your process, ice of a mushy consistency can be tolerated–but routine periodic observation is advisable.

   If the minimum allowable cold water temperature is established at or near minimum heat load, it should be safe for all operating conditions.

   Having established the minimum allowable cold water temperature, maintaining that temperature can be accomplished by fan manipulation, as outlined in Item 4 under "Tower Operation". However, in towers of more than one cell, the limiting temperature established applies to the water temperature of the cell or cells operating at the highest fan speed–not necessarily the net cold water temperature produced by the entire tower.

2. As cold air enters the louvers, it causes the falling water to be drawn inward toward the center of the tower. Thus, under fan operation, the louvers and lower periphery of the tower structure remain partly dry, seeing only random splashing from within the tower–plus normal atmospheric moisture from the entering air. Such lightly wetted areas are most subject to freezing.

   Therefore, if excessive ice forms on the louvers, stop the fan for a few minutes. With the fan off, the water flow will increase in the vicinity of the louvers and reduce the ice buildup.

3. Under extended extreme cold conditions, it may be necessary to operate the fan in reverse. This forces warm air out through the louvers, melting any accumulated ice–adequate heat load must be available. Fan reversal at half speed is recommended. Reverse operation of the fan should be used sparingly and should only be used to control ice, **not** to prevent it. Reverse fan operation should not need to exceed 1 or 2 minutes. Monitoring is required to determine the time required to melt accumulated ice.

⚠ Warning

Reverse operation of fans for prolonged periods during subfreezing weather can cause severe damage to fans and fan cylinders. Ice can accumulate inside fan cylinders at fan blade plane of rotation and fan blade tips will eventually strike this ring of ice, damaging the fan blades or cylinder. Ice can also accumulate on fan blades and be thrown off, damaging fan cylinder or blades. Allow a minimum of 10 minute delay between reverse operation and forward operation during subfreezing weather to permit ice to dissipate from fan blades and fan cylinders. See Fan Drive Caution note on page 5 for fan speed change and reversing precautions.

4. With no heat load on the circulating water, icing cannot be controlled effectively by air control during freezing weather. **Towers must not be operated with reduced water rate and/or no heat load during freezing weather.** If the circulating water system cannot be shut down, water returning from the process should be made to bypass the tower. If a bypass is used, **all** water must be bypassed without modulation. If the water bypass is directly into the tower's cold water basin, its design must be approved by Marley Engineering.

Maintenance

Intermittent Wintertime Operation

If periods of shutdown (nights, weekends, etc.) occur during freezing weather, measures must be taken to prevent the water in the cold water basin–and all exposed pipework–from freezing.

⚠ Caution

Unless some means of freeze prevention is incorporated into your system, the tower basin and exposed pipework should be drained at the beginning of each wintertime shutdown period.

⚠ Warning

If tower basin is drained, verify that all basin heaters have been shut off either by automatic cutoff or disconnect switch.

It is recommended that you discuss your freeze prevention options with your local Marley sales representative.

Water Treatment and Blowdown

Maintaining Water Quality

The materials used in your tower are selected to offer long, corrosion-free service in a "normal" cooling tower environment, defined as follows:

- Circulating water with a pH between 6.5 and 9; a chloride content (as NaCl) below 750 ppm; a sulfate content (SO_4) below 1200 ppm; carbonate or bicarbonates below 300 ppm (as $CaCO_3$); a maximum inlet water temperature not to exceed 120°F (49°C); no significant contamination with unusual chemicals or foreign substances; and adequate water treatment to minimize scaling.
  Sigma Steel Cooling Tower only.
  Circulating water with a pH between 6.5 and 8; a chloride content (as NaCl) below 500 ppm; a sulfate content (SO_4) below 250 ppm; total alkalinity below 500 ppm; calcium hardnes (as $CaCO_3$) above 50 ppm.
- Startup Conditions: The water conditions during the initial tower operation are crucial in preventing premature corrosion of galvanized steel (white rust). For at least the first eight weeks of operation, pH should be controlled between 6.5 and 8.0 with hardness and alkalinity levels between 100 and 300 ppm (expressed as $CaCO_3$).
- Chlorine if added intermittently, with a free residual not to exceed 1 ppm–maintained for short periods. Free residual should not exceed 0.4 ppm if chlorine is added continuously. Excessive chlorine levels may deteriorate sealants and other materials of construction.

Maintenance

- An atmosphere surrounding the tower no worse than “moderate industrial”, where rainfall and fog are no more than slightly acid, and they do not contain significant chlorides or hydrogen sulfide (H_2S).

Cooling tower cleaning

⚠ Warning

Any evaporative-type cooling tower must be thoroughly cleaned on a regular basis to minimize the growth of bacteria, including Legionella Pneumophilia, to avoid the risk of sickness or death. Service personnel must wear proper personal protective equipment during decontamination. Do NOT attempt any service unless the fan motor is locked out.

Operators of evaporative cooling equipment, such as water cooling towers, should follow maintenance programs which will reduce to an absolute minimum the opportunity for bacteriological contamination. Public Health Service officials have recommended that “good housekeeping” procedures be followed, such as: regular inspections for concentrations of dirt, scale, and algae; periodic flushing and cleaning; and the following of a complete water treatment program including biocidal treatment. See **Tower Startup** instructions on page 3.

The visual inspection should take place at least once a week during the operating season. The periodic flushing and cleaning should be done before and after each cooling season, but in any event at least twice a year. The hot water basins and nozzles, louvers, drift eliminators, and easily accessible fill surfaces should be flushed by use of a moderate-pressure water nozzle, being careful not to cause physical damage. A reliable water treatment program should be installed and maintained. Filtration devices may be employed to reduce the suspended solids concentrations, thus increasing the effectiveness of the water treatment program.

Blowdown

A cooling tower cools water by continuously causing a portion of it to evaporate. Although the water lost by evaporation is replenished by the makeup system, it exits the tower as pure water–leaving behind its burden of dissolved solids to concentrate in the remaining water. Given no means of control, this increasing concentration of contaminants can reach a very high level.

Maintenance

Cooling Range (°F)	Blowdown Rate: Two Concentrations	Blowdown Rate: Four Concentrations
10	0.7%	0.17%
15	1.1%	0.30%
20	1.5%	0.43%

* "Range" = Difference between hot water temperature entering the tower & cold water temperature leaving the tower.

In order to achieve water quality which is acceptable to the cooling tower (as well as the remainder of your circulating water system), the selected water treatment company must work from a relatively constant level of concentrations. This stabilization of contaminant concentrations is usually accomplished by blowdown, which is the constant discharge of a portion of the circulating water to waste. As a rule, acceptable levels on which to base a treatment schedule will be in the range of 2-4 concentrations. The table above gives approximate rates of blowdown (percent of total water flow rate constantly wasted) to achieve those concentrations at various cooling ranges.

Note

When water treatment chemicals are added, they should not be introduced into the circulating water system via the cold water basin of the cooling tower. Water velocities are lowest at that point, which results in inadequate mixing.

Schedule of Tower Maintenance

Included in the instruction packet are separate *User Manuals on each major operating component of the tower, and it is recommended that you read them thoroughly. Where discrepancies may exist, the separate User Manuals will take precedence.*

The following is recommended as a minimum routine of scheduled maintenance:

⚠ Warning

Always shut off electrical power to the tower fan motor prior to performing any inspections that may involve physical contact with the mechanical or electrical equipment in or on the tower. Lock out and tag out any electrical switches to prevent others from turning the power back on. Service personnel must wear proper personal protective clothing and equipment.

Daily: Observe, touch, and listen to the tower for a few moments each day. Become accustomed to its normal appearance, sound, and level of vibration. Abnormal aspects relating to the rotating equipment should be considered reason to shut down the tower until the problem can be located and corrected.

Maintenance

Weekly: Observe operation of the motor, drive shaft, Geareducer and fan. Become familiar with the normal operating temperature of the motor, as well as the sight and sound of all components as a whole.

Shut off the fan for a few minutes, check the level of oil in the Geareducer. Add oil as necessary. Check system for leaks if the amount of oil required appears unusual. (If oil is added at the external fill port, allow adequate time for the level to stabilize before reading final level.)

Inspect louvers and basin trash screens, and remove any debris which may have accumulated. Replace any damaged or worn out components. Use of high-pressure water may damage the eliminator and louver material.

Check for any buildup of silt on the floor of the cold water basin. Mentally note the amount, if any, so future inspections will enable you to determine the rate at which it is forming.

Inspect for bacterial growth and general operating conditions. Bacterial growth should be reported to your water treatment expert for immediate attention.

Monthly: Check Geareducer oil sample for presence of water and/or sludge. Make sure vents are open. (See Geareducer Manual.)

Semi-Annually: Drain Geareducer and refill with fresh oil, as outlined in the Geareducer Manual. If sludge is present in the oil, flush Geareducer before refilling.

Note

Oil changes have been reduced to 5-year intervals for Geareducer models 10.1, 1800, 2000, 2200 and 2400. To maintain five-year change intervals, use only oil designed specifically for these Geareducers. If, after five years, turbine-type mineral oil is used, the oil must be changed semi-annually. Refer to Geareducer Manual for oil recommendations and further instructions.

Relubricate motor according to the manufacturer's instructions.

Check to see that all bolts are tight in the fan and mechanical equipment region, including the fan cylinder. Use torque settings prescribed in the Fan Manual.

Remove any accumulated debris, dirt, or algae from the hot water basins and the distribution nozzles. Make sure that all nozzle metering orifices are in place.

Visually inspect the drift eliminators. Remove any accumulated debris or scale.

Maintenance

Clean and disinfect cooling tower with biocides. Systems with biofouling, high general bacterial counts, or positive cultures of legionella may require additional cleaning. Refer to “Cooling Tower Cleaning” section. Consult your water treatment expert as to prudent biological evalutaion testing.

Annually: Inspect the tower thoroughly, making maximum use of instructions given in the separate service manuals. Check structural bolted connections and tighten as required. Make preventive maintenance repairs as considered necessary.

Every 5 Years: Geareducer models 10.1, 1800, 2000, 2200, and 2400 only. Change Geareducer oil. Refer to Geareducer Manual for instructions.

Spare Parts

If your tower application is critical, you should consider maintaining a stock of replacement mechanical equipment components. We recommend these parts for your spare parts inventory:

1. One fan assembly
2. One Geareducer assembly
3. One drive shaft assembly

Be sure to include the tower model number and serial number when you order parts.

Seasonal Shutdown Instructions

When the system is to be shut down for an extended period of time, it is recommended that the entire system (cooling tower, system piping, heat exchangers, etc.) be drained. Leave the basin drain open.

During shutdown, clean the tower and make any necessary repairs. Pay particular attention to mechanical equipment supports and drive shafts.

Protect wood towers against fire. If you choose to wet down your tower for fire protection, use a continuous wet-down system. Alternate wetting and drying can severely damage lumber.

Tower framework: Check structural bolted connections and tighten as required.

Maintenance

Geareducers (except 10.1, 1800, 2000, 2200, and 240**0**)

1. Each month during shutdown, drain any water that may have condensed inside the Geareducer and lubrication system. (This can be done at the external drain plug near the motor.) Check oil level and add oil if necessary. Operate Geareducer to re-coat all interior surfaces with oil.
2. Check Geareducer anchor bolts and tighten as required.
3. At next season startup, operate Geareducer until oil is warm–change oil.

Fans: Check fan assembly bolting and tighten as required. (Use torque settings prescribed on the fan nameplate.)

Electric motors: Clean and lubricate motor at close of each operating season. (Refer to motor manufacturer's recommendations.) Check motor anchor bolts and tighten as required.

⚠ **Caution**

Do not start motor before determining that there will be no interference with free rotation of the fan drive.

The motor should be operated for three hours at least once a month. This serves to dry out windings and re-lubricate bearing surfaces. (Refer to Marley electric motor service manual.)

At the start of a new operating season, make sure bearings are adequately lubricated before returning motor to service.

Flow Control Valves: Apply a marine type lithium base grease at the grease fitting of each valve, and then open valve. Coat exposed valve stem with grease.

Fiberglass Components: Check all fiberglass parts for exposed glass fibers. If found, the affected surfaces should be roughened up and solvent wiped. Surfaces must be clean and dry and free of oil, grease or other contaminants before applying new coating. The best coating system requires using a two-part polyamide epoxy primer to promote adhesion and a two-part acrylic polyurethane enamel for the topcoat. Contact your Marley sales representative if additional information is required.

Prolonged Shutdown:

If shutdown period is longer than seasonal, contact your Marley sales representative for additional information.

Additional Information

Marley Services

Marley's interest in your cooling tower does not end with the sale. Having conceived, designed, and manufactured the most reliable and longest-lasting cooling tower of its class, we want to make sure that you gain the maximum possible benefit from its purchase.

Therefore, the following services are available which are intended to assure the maximum possible service life under your operating conditions, tailor the operating characteristics to your specific needs, and maintain consistently optimum thermal performance capability. They are available by contacting your Marley sales representative.

Replacement parts: With the exception of the motor, every component of your tower is designed and manufactured by Marley. We do this because commercially available components have not proved capable of withstanding the harsh environment of a cooling tower – nor do they contribute their share to the thermal capability and operating characteristics intended.

A stock of most parts and components is maintained at one or more of the various Marley plants. In cases of emergency, they can normally be shipped within 24 hours—by air freight if necessary. However, we would recommend that you anticipate their need in advance, and avoid the cost of special handling.

Be sure to mention your tower serial number (from the tower nameplate) when ordering parts.

Periodic maintenance: You may wish to contract with Marley for regularly scheduled visits for the purpose of inspecting and reporting your tower's condition, to make recommendations intended to prevent emergencies, and to perform maintenance considered outside the norm.

This service is not intended to replace the important function performed by your maintenance staff. Their attention assures the tower's routine operating performance, and is invaluable. However, Marley recognizes that the unusual manner in which a cooling tower performs its function, as well as the unique forces which act upon it, may be considerations which occasionally require the services of an expert technician.

Additional Information

Increased load requirements: Marley towers are designed so that cells of either equal or unequal capacity can be added in the future. This allows you to compensate for the load increases that normally occur with the replacement or addition of production equipment and still retain continuity with respect to your cooling tower system.

Tower rebuilding: Marley routinely rebuilds and upgrades cooling towers of all materials and makes. If your tower ever reaches the limit of its service life, we recommend that you investigate the cost of rebuilding before you routinely order a new replacement tower.

Marley also provides several sets of a separate packet of pertinent operating and maintenance manuals. The manuals vary somewhat depending on the tower model purchased.

In addition, Marley publishes numerous technical reports including more detailed information on a variety of cooling tower operation and service topics. Your Marley sales representative will be happy to give you copies of these reports at no charge. These publications can also be located at spxcooling.com.

For complete parts and service assistance, contact the Marley sales or representative office in your area. If you need help locating the office nearest you, please phone 913 664 7400 or check the internet at spxcooling.com.

Troubleshooting

Trouble	Cause	Remedy
Motor will not start	Power not available at motor terminals	1. Check power at starter. Correct any bad connections between the control apparatus and the motor. 2. Check starter contacts and control circuit. Reset overloads, close contacts, reset tripped switches or replace failed control switches. 3. If power is not on all leads at starter make sure overload and short circuit devices are in proper condition.
	Wrong connections	Check motor and control connections against wiring diagrams.
	Low voltage	Check nameplate voltage against power supply. Check voltage at motor terminals.
	Open circuit in motor winding	Check stator windings for open circuits.
	Motor or fan drive stuck	Disconnect motor from load and check motor and Geareducer for cause of problem.
	Rotor defective	Look for broken bars and rings.
Unusual motor noise	Motor running single-phase	Stop motor and attempt to start it. Motor will not start if single-phased. Check wiring, controls and motor.
	Motor leads connected incorrectly	Check motor connections against wiring diagram on motor.
	Bad bearings	Check lubrication. Replace bad bearings.
	Electrical unbalance	Check voltage and currents of all three lines. Correct if required.
	Air gap not uniform	Check and correct bracket fits or bearing.
	Rotor unbalance	Rebalance.
	Cooling fan hitting end bell guard	Reinstall or replace fan.
Fan noise	Blade rubbing inside of fan cylinder	Adjust cylinder to provide blade tip clearance.
	Loose bolts in blade clamps	Check and tighten if necessary. Check fan blade pitch. Refer to Fan Service Manual.
Scale or foreign substance in water system	Lack of or insufficient bleed-off	See “Water Treatment” section of this manual.
	Water treatment	Consult competent water treating specialist. See “Water Treatment” section of this manual.
Motor does not come up to speed	Voltage too low at motor terminals because of line drop	Check transformer and setting of taps. Use higher voltage on transformer terminals or reduce loads. Increase wire size or reduce inertia.
	Broken rotor bars	Look for cracks near the rings. A new rotor may be required. Have motor service center check motor.
Wrong rotation (Motor)	Wrong sequence of phases	Switch any two of the three motor leads.
Excessive water drift	Faulty drift elimination	1. See if all louvers and eliminators are in place and clean. 2. Check to see that nozzles are in place and clean of debris.
	Overpumping	Reduce water flow rate to tower to design conditions.
Cold water too warm (See “Tower Operation”)	Overpumping	Reduce water flow rate to tower to design conditions.
	Not enough air	Check motor current and voltage to be sure of correct contract horsepower. Clean louvers, fill and eliminators.

Troubleshooting

Trouble	Cause	Remedy
Unusual fan drive vibration	Loose bolts and cap screw	Tighten all bolts and cap screws on all mechanical equipment and supports.
	Worn coupling or misalignment	Make sure motor and Geareducer shafts are in proper alignment and “match marks” properly matched. Repair or replace worn couplings.
	Unbalanced fan	Be sure blades are properly positioned in correct sockets. (See match numbers.) Make certain all blades are as far from center of hub as safety devices permit. All blades must be pitched the same. See Fan Service Manual. Clean off deposit buildup on blades. Check fan and pinion shaft endplay. Replace bearings as neces-
	Worn Geareducer bearings	sary.
	Unbalanced motor	Disconnect load and operate motor. If motor still vibrates, rebalance rotor.
	Bent Geareducer shaft	Check fan and pinion shafts with dial indicator. Replace if neces-
Motor runs hot	Motor overload, wrong voltage or unbal-	sary.
	anced voltage	Check voltage and current of all three lines against nameplate values.
	Wrong motor RPM	Check nameplate against power supply. Check RPM of motor and gear ratio.
	Bearings overgreased	Remove grease reliefs. Run motor up to speed to purge excessive grease.
	Wrong lubricant in bearings	Change to proper lubricant. See motor manufacturer’s instructions.
	One phase open	Stop motor and attempt to start it. Motor will not start if single-phased. Check wiring, controls and motor.
	Poor ventilation	Clean motor and check ventilation openings. Allow ample ventila- tion around motor.
	Winding fault	Check with Ohmmeter.
	Bent motor shaft	Straighten or replace shaft.
	Insufficient grease	Remove plugs and regrease bearings.
	Too frequent starting	Limit cumulative starting time to a total of 30 seconds each hour.
	Deterioration of or foreign material in grease	Flush bearings and re-lubricate.
	Bearings damaged	
	Incorrect fan blade pitch	Replace bearings.
		Measure actual fan pitch and compare to that recommended. Cor-
	Geareducer bearings	rect, if necessary. See Fan Service Manual.
Geareducer noise		If new, see if noise disappears after one week of operation. Drain, flush and refill Geareducer. See Geareducer Service Manual. If still noisy, replace bearings.
	Gears	Correct tooth engagement. Replace badly worn gears. Replace gears with imperfect tooth spacing or form.
	Improper water treatment or	See Water Treatment section of this manual. Contact your Marley sales representative
Wood deterioration	microbiological attack	

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COOLING TECHNOLOGIES

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